SECTION 1: IDENTIFICATION OF THE PRODUCT AND OF THE COMPANY

1.1 Product identifiers
Product Name: ACS Material Monolayer WSe₂ on SiO₂ Substrate
Brand: ACS Material LLC
CAS-No.: 12067-46-8 (WSe₂); 60676-86-0 (SiO₂)

1.2 Relevant identified uses of the substance or mixture and uses advised against
Identified uses: Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet
Company: ACS MATERIAL LLC
959 E Walnut St., Suite 100
Pasadena, CA 91106
USA
Telephone: +1 (866)-227-0656
Fax: +1 (781)-518-0284

1.4 Emergency telephone number
Emergency Phone #: +1 (866)-227-0656

SECTION 2: HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture
GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Oral (Category 3), H301
Acute toxicity, Inhalation (Category 3), H331
Specific target organ toxicity - repeated exposure (Category 2), H373
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (Category 1), H410
For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements
Pictogram

Signal word Danger

Hazard statement(s)
H301 + H331 Toxic if swallowed or if inhaled
H373 May cause damage to organs through prolonged or repeated exposure.
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)
P260 Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264 Wash skin thoroughly after handling.
P270 Do not eat, drink or smoke when using this product.
P271 Use only outdoors or in a well-ventilated area.
P273 Avoid release to the environment.
P301 + P310 + P330 IF SWALLOWED: Immediately call a POISON CENTER/doctor. Rinse mouth.
P304 + P340 + P311 IF INHALED: Remove person to fresh air and keep comfortably breathing. Call a POISON CENTER/doctor.
P314 Get medical advice/ attention if you feel unwell.
P391 Collect spillage.
P403 + P233 Store in a well-ventilated place. Keep container tightly closed.
P405 Store locked up.
P501 Dispose of contents/ container to an approved waste disposal

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS
None.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

<table>
<thead>
<tr>
<th>Substance name</th>
<th>ACS Material Monolayer WSe\textsubscript{2} on SiO\textsubscript{2} Substrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS-No</td>
<td>12067-46-8</td>
</tr>
<tr>
<td>Synonyms</td>
<td>Tungsten (IV) selenide</td>
</tr>
<tr>
<td></td>
<td>Tungsten selenide</td>
</tr>
<tr>
<td>Molecular weight</td>
<td>341.76 g/mol</td>
</tr>
<tr>
<td>Linear formula</td>
<td>WSe\textsubscript{2}</td>
</tr>
</tbody>
</table>

| CAS-No         | 60676-86-0                                                                      |
| Synonyms       | Silica                                                                          |
|                | Quartz                                                                          |
|                | Sand                                                                            |
|                | Cristobalite                                                                    |
| Molecular weight | 60.08 g/mol                                                                     |
Linear formula: SiO₂

**Hazardous ingredients**
Chemical characterization: Tungsten diselenide, crystalline, synthetic, non fibrous

<table>
<thead>
<tr>
<th>Components</th>
<th>Concentration</th>
<th>CAS No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tungsten diselenide</td>
<td>&lt;=100%</td>
<td>12067-46-8</td>
</tr>
</tbody>
</table>

For the full text of the phrases mentioned in this Section, see Section 16.

**Hazardous impurities:** None known.

**SECTION 4: FIRST AID MEASURES**

4.1 **Description of first aid measures**

**General advice**
Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

**If inhaled**
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

**In case of skin contact**
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

**In case of eye contact**
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

**If swallowed**
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 **Most important symptoms and effects, both acute and delayed**
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11.

4.3 **Indication of any immediate medical attention and special treatment needed**
No data available.

**SECTION 5: FIREFIGHTING MEASURES**
5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Silicon oxides.

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: HANDLING AND STORAGE

7.1 Precautions for safe handling

Suitable extinguishing media
Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs. Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.
7.2 Conditions for safe storage, including any incompatibilities
Store in cool place. Keep container tightly closed in a dry and well-ventilated place.
Air-, heat-, and moisture-sensitive. Store under nitrogen. Recommended storage temperature 2 - 8 °C.
Substrate: strongly hygroscopic. Storage class (TRGS 510): Non Combustible Solids

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

<table>
<thead>
<tr>
<th>Components</th>
<th>CAS-No.</th>
<th>Value</th>
<th>Control Parameters</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tungsten diselenide</td>
<td>12067-46-8</td>
<td>TWA</td>
<td>0.2 mg/m³</td>
<td>USA. Occupational Exposure Limits (OSHA) - Table Z-1 LIm for Air Contaminants</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA</td>
<td>0.2 mg/m³</td>
<td>USA. ACGIH Threshold Limit Values (TLV)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Remarks: Upper Respiratory Tract irritation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Eye irritation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA</td>
<td>5 mg/m³</td>
<td>USA. ACGIH Threshold Limit Values (TLV)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Respiratory Tract irritation varies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STEL</td>
<td>10 mg/m³</td>
<td>USA. ACGIH Threshold Limit Values (TLV)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Respiratory Tract irritation varies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA</td>
<td>0.2 mg/m³</td>
<td>USA. NIOSH Recommended Exposure Limits</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA</td>
<td>5 mg/m³</td>
<td>USA. NIOSH Recommended Exposure Limits</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ST</td>
<td>10 mg/m³</td>
<td>USA. NIOSH Recommended Exposure Limits</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PEL</td>
<td>0.2 mg/m³</td>
<td>California permissible exposure limits for chemical contaminan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(Title 8, Article 107)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PEL</td>
<td>5 mg/m³</td>
<td>California permissible exposure limits</td>
</tr>
</tbody>
</table>
8.2 Exposure controls

Appropriate engineering controls
Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

8.3 Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove’s outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N99 (US) or type P2 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES
9.1 Information on basic physical and chemical properties

1) Appearance
   Form: crystalline
   Colour: metallic

2) Odour
   No data available

3) Odour Threshold
   No data available

4) pH
   No data available

5) Melting point/freezing point
   Melting point/range: 1,200 °C (2,192 °F)

6) Initial boiling point and boiling range
   No data available

7) Flash point
   No data available

8) Evaporation rate
   No data available

9) Flammability (solid, gas)
   No data available

10) Upper/lower flammability or explosive limits
    No data available

11) Vapour pressure
    No data available

12) Vapour density
    No data available

13) Relative density
    No data available

14) Water solubility
    No data available

15) Partition coefficient: n-octanol/water
    No data available

16) Auto-ignition temperature
    No data available

17) Decomposition temperature
    No data available

18) Viscosity
    No data available

19) Explosive properties
    No data available

20) Oxidizing properties
    No data available

9.2 Other safety information

Bulk density(SiO₂) 480 - 600 kg/m³

SECTION 10: STABILITY AND REACTIVITY

10.1 Reactivity
No data available.

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available.

10.4 Conditions to avoid
No data available.
10.5 Incompatible materials
Strong oxidizing agents.

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Tungsten oxide, Selenium/selenium oxides.
Other decomposition products - No data available
In the event of fire: see section 5.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
WSe$_2$:
No data available.
Inhalation: No data available.
Dermal: No data available.
No data available.

SiO$_2$:
LD$_{50}$ Oral - rat - > 5,000 mg/kg
Inhalation: no data available
Dermal: no data available

Skin corrosion/irritation
No data available.

Serious eye damage/eye irritation
No data available.

Respiratory or skin sensitisation
No data available.

Germ cell mutagenicity
No data available.

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.
Reproductive toxicity
No data available.

Specific target organ toxicity - single exposure
No data available.

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: YO7714000
To the best of our knowledge, the chemical, physical, and toxicological properties of WSe₂ have not been thoroughly investigated.

SECTION 12: ECOLOGICAL INFORMATION

12.1 Toxicity
No data available.

12.2 Persistence and degradability
No data available.

12.3 Bioaccumulative potential
No data available.

12.4 Mobility in soil
No data available.

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted.

12.6 Other adverse effects
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal. Very toxic to aquatic life with long lasting effects.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods
Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.
Contaminated packaging
Dispose of as unused product.

SECTION 14: TRANSPORT INFORMATION

UN number
ADR/RID: 3283
IMDG: 3283
IATA: 3283

UN proper shipping name
ADR/RID: Selenium compound, solid, n.o.s. (Tungsten diselenide)
IMDG: SELENIUM COMPOUND, SOLID, N.O.S. (Tungsten diselenide)
IATA: Selenium compound, solid, n.o.s. (Tungsten diselenide)

Transport hazard class(es)
ADR/RID: 6.1
IMDG: 6.1
IATA: 6.1

Packaging group
ADR/RID: III
IMDG: III
IATA: III

Environmental hazards
ADR/RID: No data available.
IMDG Marine pollutant: yes
IATA: No data available.

Special precautions for user
No data available.

SECTION 15: REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Authorisations and/or restrictions on use

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by
Safety Data Sheet – Monolayer WSe$_2$ on SiO$_2$  

SARA Title III, Section 313:  

<table>
<thead>
<tr>
<th>CAS-No.</th>
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</thead>
<tbody>
<tr>
<td>Tungsten diselenide</td>
<td>12067-46-8</td>
</tr>
</tbody>
</table>

**SARA 311/312 Hazards**  
Acute Health Hazard.

**Massachusetts Right To Know Components**  
No components are subject to the Massachusetts Right to Know Act.

**Pennsylvania Right To Know Components**  

<table>
<thead>
<tr>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tungsten diselenide</td>
<td>12067-46-8</td>
</tr>
<tr>
<td>Silicon dioxide</td>
<td>-</td>
</tr>
</tbody>
</table>

**New Jersey Right To Know Components**  

<table>
<thead>
<tr>
<th>CAS-No.</th>
<th>Revision Date</th>
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</thead>
<tbody>
<tr>
<td>Tungsten diselenide</td>
<td>12067-46-8</td>
</tr>
<tr>
<td>Silicon dioxide</td>
<td>-</td>
</tr>
</tbody>
</table>

**California Prop. 65 Components**  
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

**SECTION 16: OTHER INFORMATION**  

Full text of H-Statements referred to under sections 2 and 3.

- **Acute Tox.** Acute toxicity
- **Aquatic Acute** Acute aquatic toxicity
- **Aquatic Chronic** Chronic aquatic toxicity
- **H301** Toxic if swallowed.
- **H301 + H331** Toxic if swallowed or if inhaled
- **H331** Toxic if inhaled.
- **H373** May cause damage to organs through prolonged or repeated exposure.
- **H400** Very toxic to aquatic life.

**HMIS Classification**  
Health hazard: 2  
Chronic Health Hazard:  
Flammability: 0
Physical Hazard: 0

**NFPA Rating**  
Health hazard: 2  
Fire Hazard: 0  
Reactivity Hazard: 0

**Disclaimer:** ACS Material, LLC believes that the information in this Safety Data Sheet is accurate and represents the best and most current information available to us. ACS Material makes no representations or warranties either express or implied, regarding the suitability of the material for any purpose or the accuracy of the information contained within this document. Accordingly, ACS Material will not be responsible for damages resulting from use of or reliance upon this information.